TKR TEM Diagnostic Data Scan

STR 14

6 July 2005

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Purpose of the test

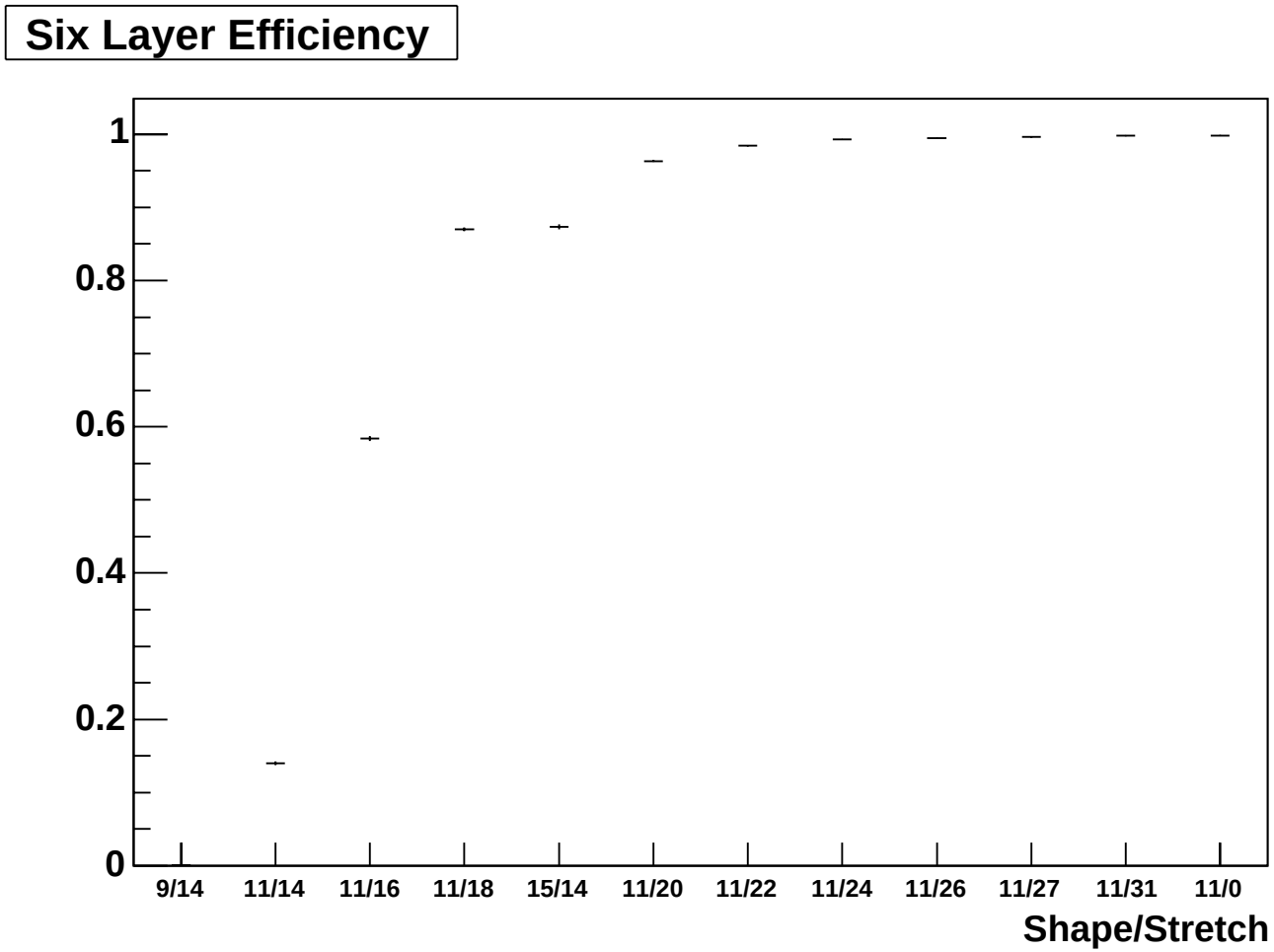
- After enabling the one-shot with a stretch of the layer trigger signal of 14, the range of latching diagnostic data was limited to the region from the start of the trigger window through 2 ticks past the end of the trigger window.
- The tracker opens the window by a coincidence of 6 layers. The last layer determines the window open time, so the earlier layers cannot be latched with the present settings.
- The objective of this STR was to investigate how many ticks before opening the window would have to be included into the latching of the diagnostic data for high diagnostics efficiency.

Test Setup

- Use one tower (Bay 8).
- Enable only 6 layers for triggering (layers 0, 1, 2 in x and y).
- Allow only the TKR to open the window.
- If there is a trigger, we know there should have been exactly 6 layers with diagnostic hits.
- Take runs with 20,000 events each with different settings of stretch and shape. The stretch is the main parameter since the shape parameter maxes out quickly (above 11 we lose the late part of the window, 15 is the maximum value).
- Record efficiency for each run.
- Settings are recorded in the e-logbook.

Six Layer efficiency

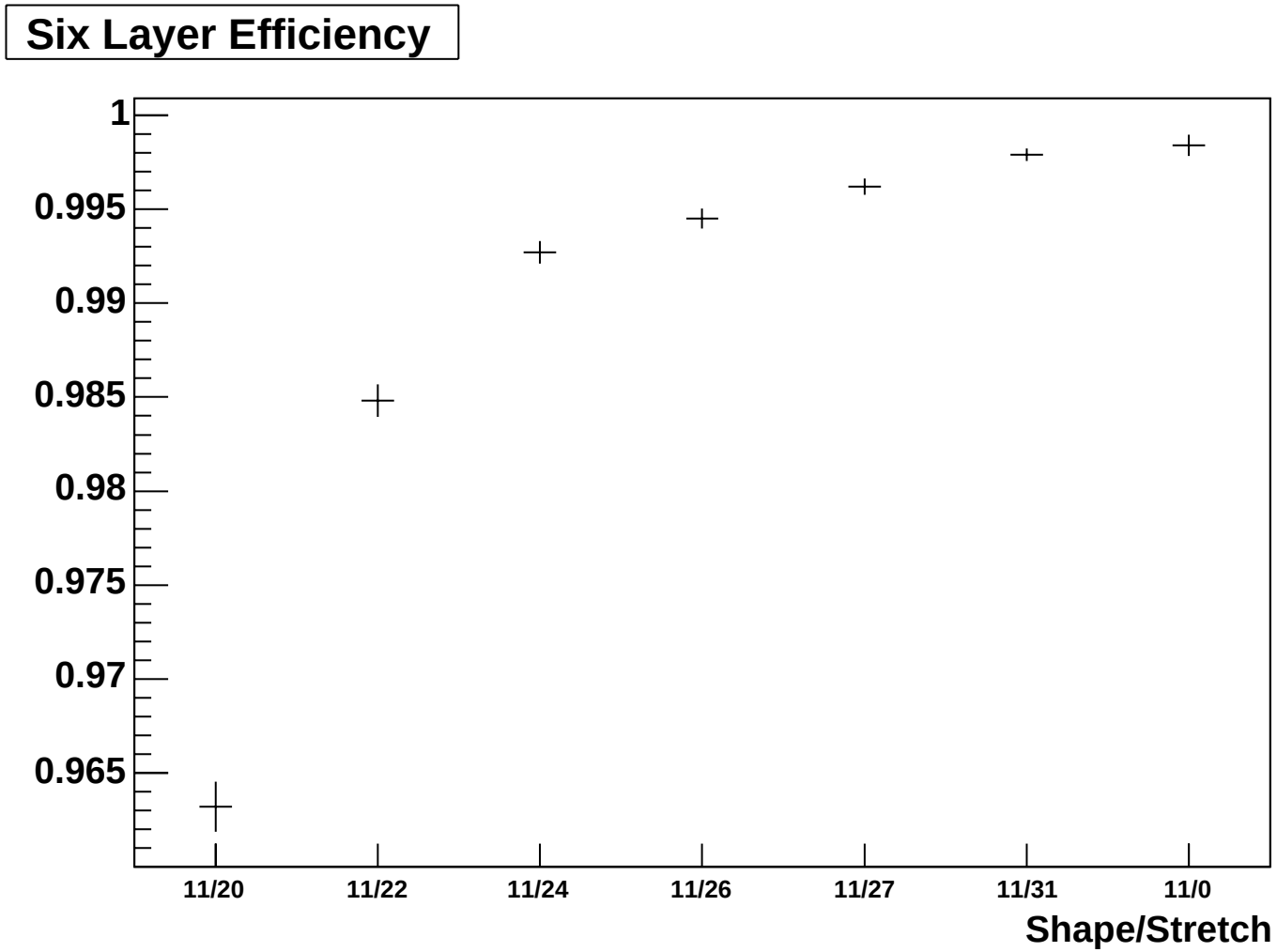
The six layer efficiency is the number of events with six layers of diagnostic hits over the total number of events.



Setting 11/18 is equivalent to 15/14. Setting 9/14 is used now.

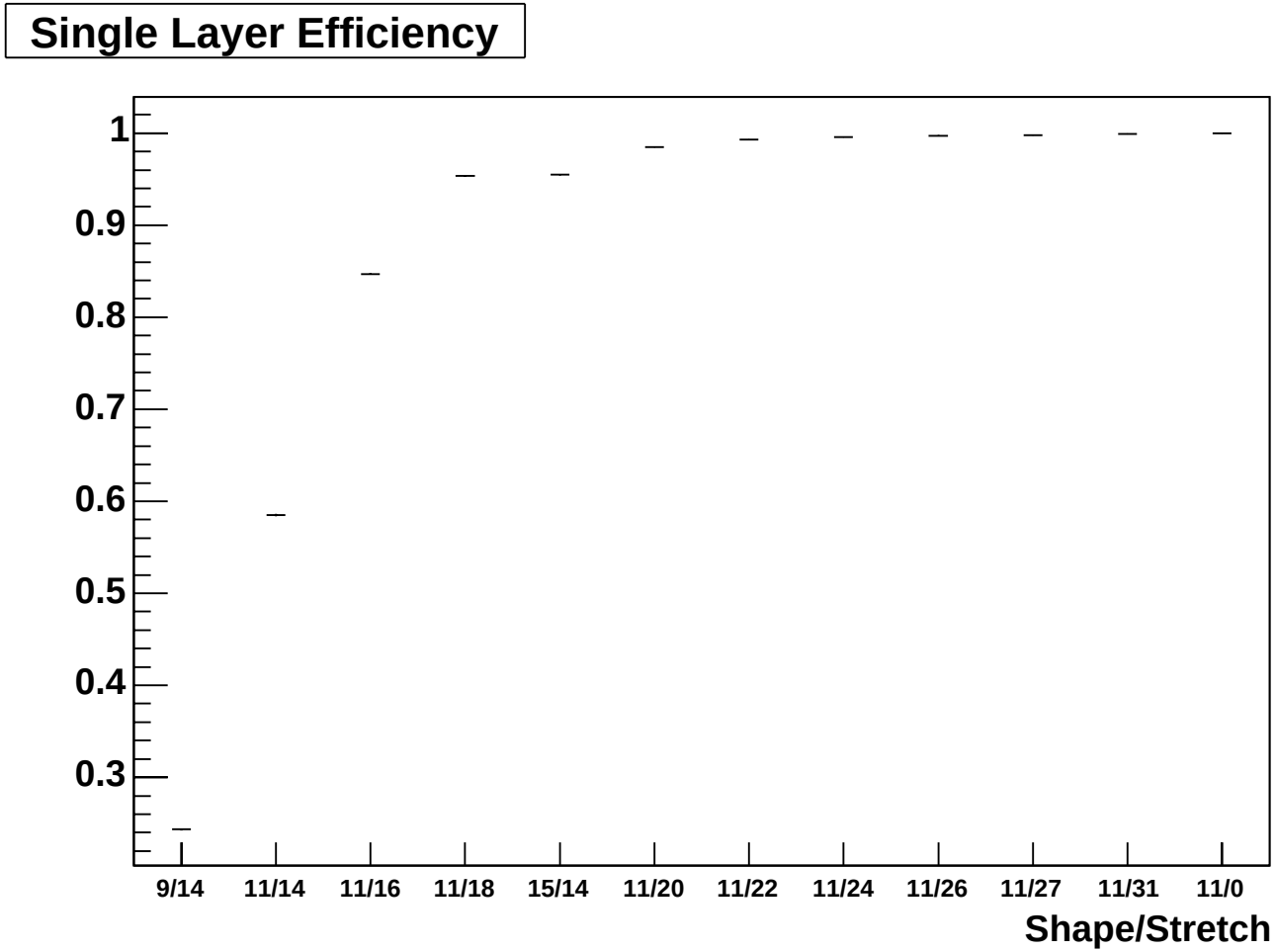
Six Layer efficiency (Zoom)

Zoom of the high efficiency region:



Single Layer efficiency

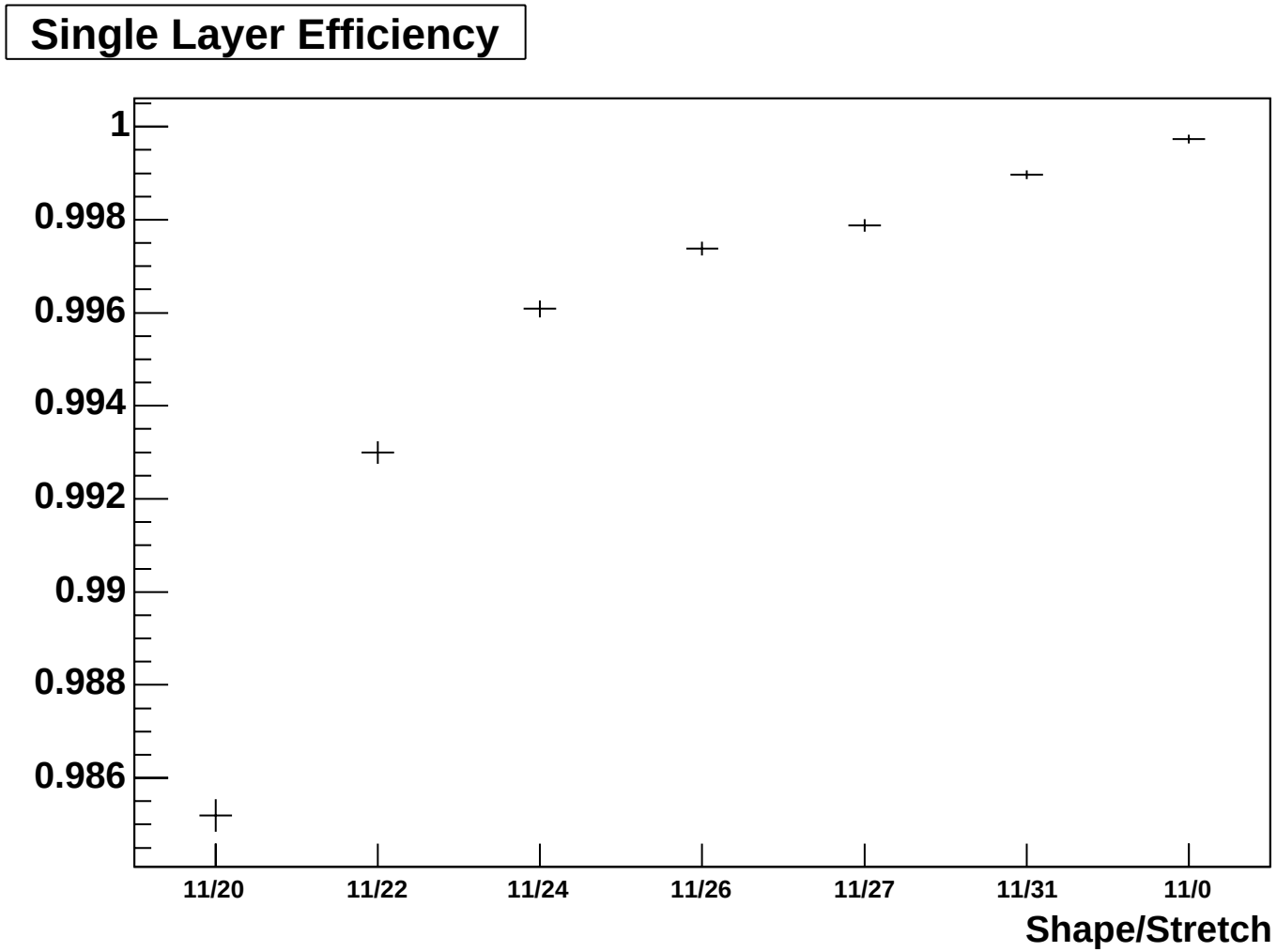
The single layer efficiency is the number of diagnostic hits over the expected number of diagnostic hits.



Setting 11/18 is equivalent to 15/14. Setting 9/14 is used now.

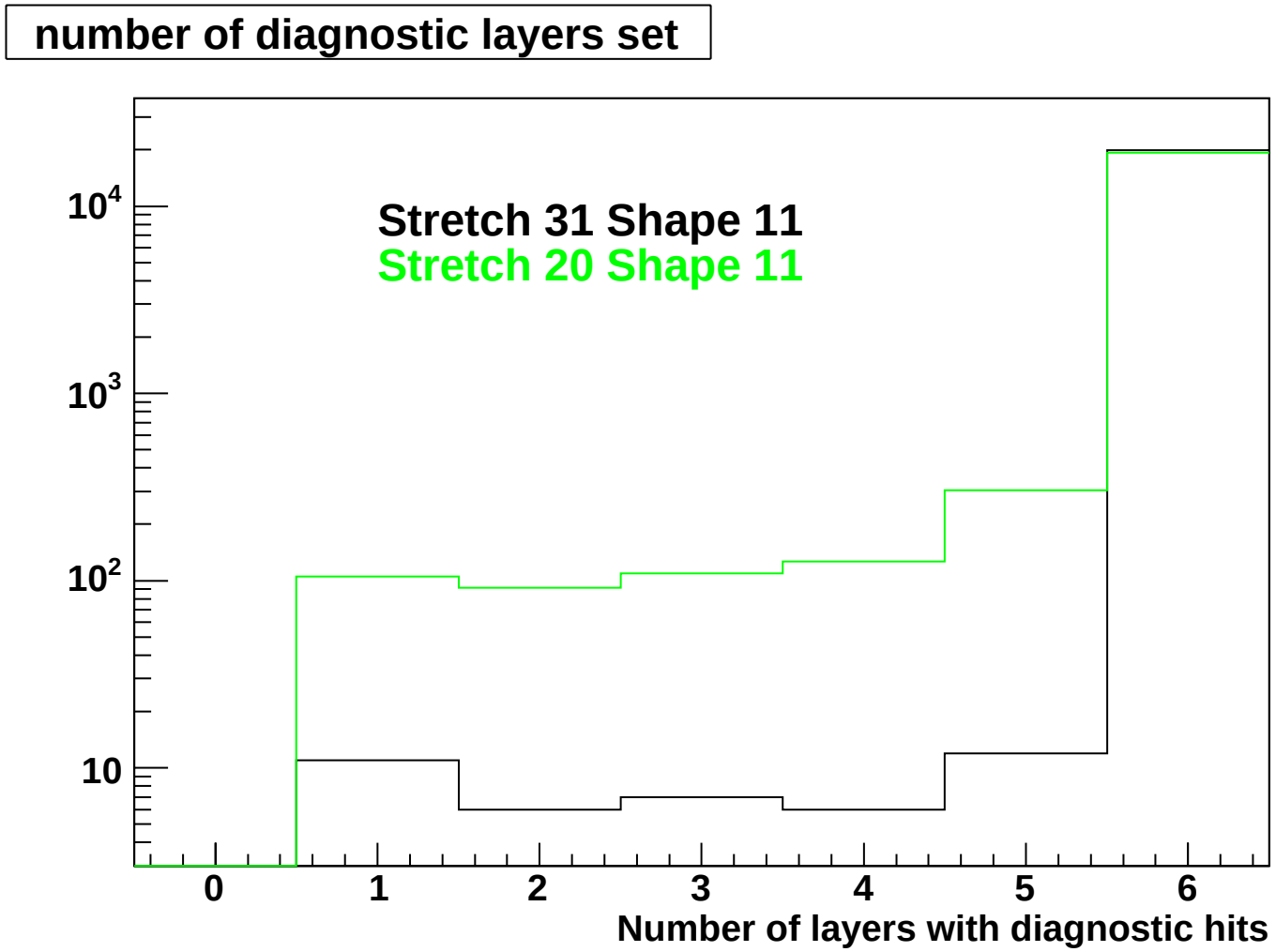
Single Layer efficiency (Zoom)

Zoom of the high efficiency region:



Layer distribution

Number of layers with diagnostic hits for two settings:



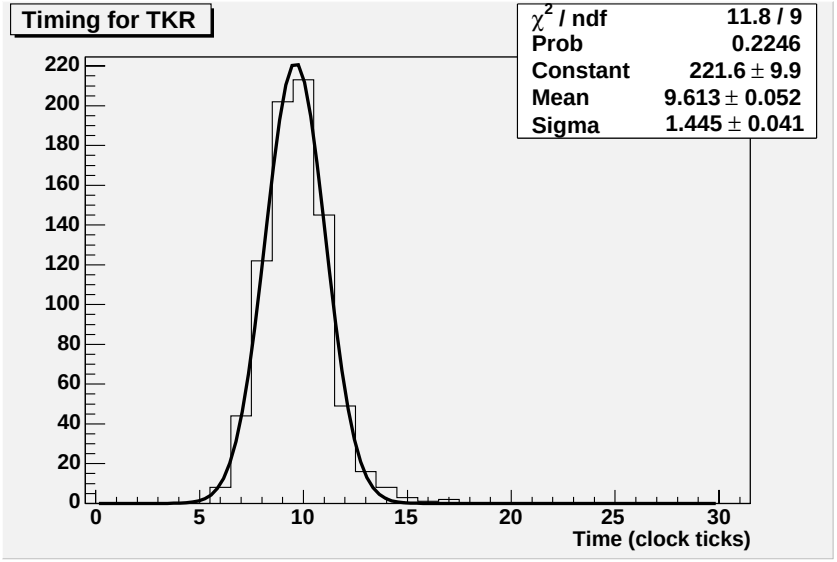
Interpretation

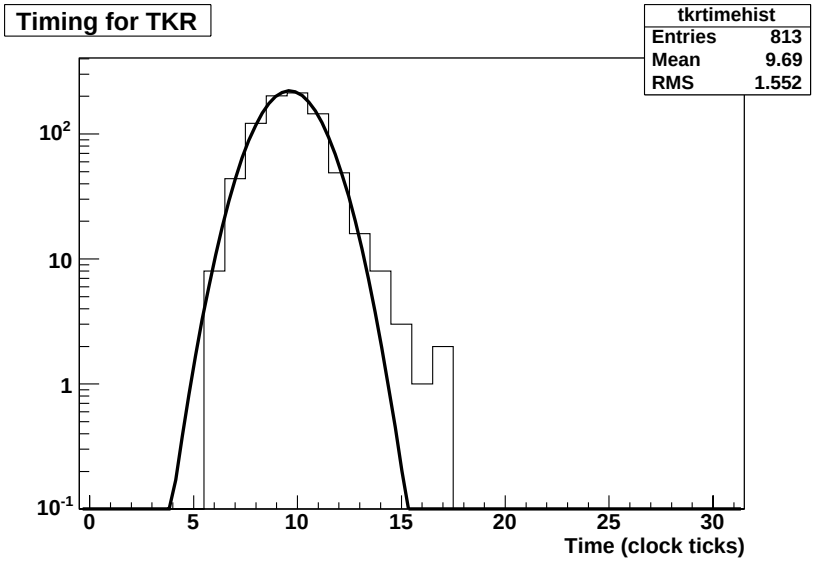
- The efficiency rises more slowly than expected.
- The original expectation of 3 σ = 5 - 6 ticks missed a factor of 2 since it should be $\pm 3\sigma$ = 10 - 12 ticks.
- This value is reasonable, but the efficiency is not as high as expected
- The number-of-layers distribution does not look as expected
- The assumption of a Gaussian timing distribution does not seem justified.

$\Longrightarrow$ Look at single layer timing distribution.

Single layer timing

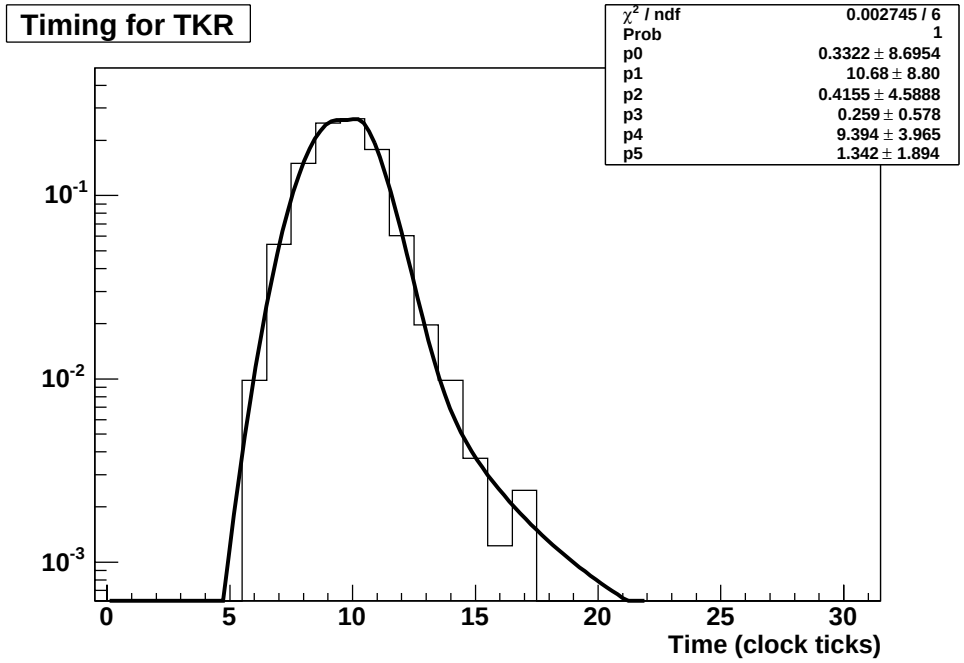
Single layer timing (STR 2) with Gaussian fit, lin and log plot:





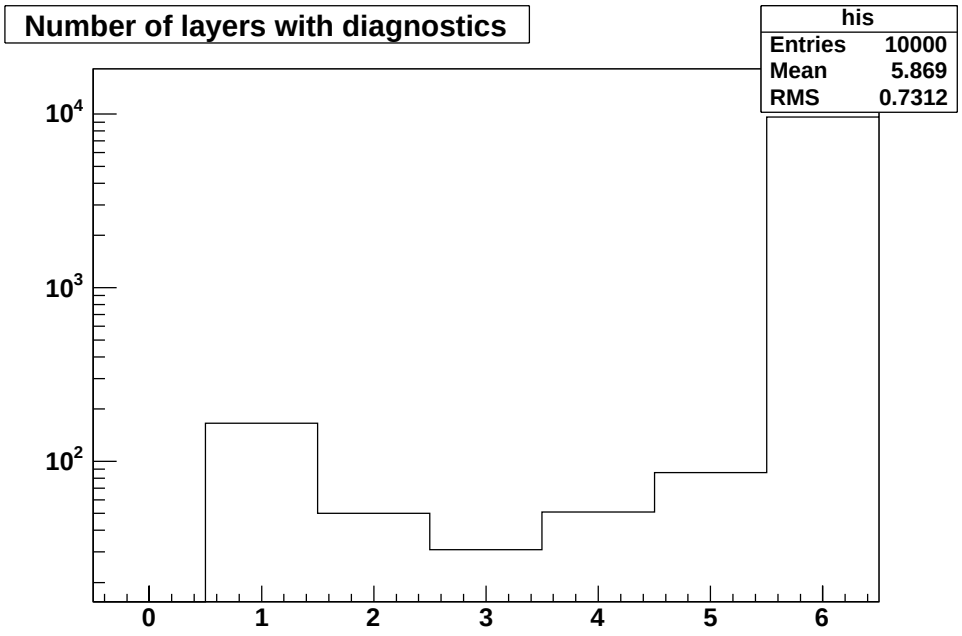
Toy MC

- Does the tail explain the observations?
- Do a fit with Gauss + Landau and use this as a PDF for a toy MC to compare to data.
- This is just a simple model, a good model for the timing would be quite complicated.



Toy MC 2

- The efficiency rises even slower than for data (97.8 % at 11/24, 99.2 % in data)
- Bin 1 is even more pronounced than in data (11/20 setting):



$\Longrightarrow$ The tail does provide an explanation of the observations.

Conclusions and Summary

- The efficiency rises more slowly than expected. This is now understood. The cause is the high tail in the single layer timing distribution.
- With the one-shot set, we cannot have 100 % latching efficiency for the tracker because of range limitations of the parameters that control the diagnostics latching.
- To achieve a six-layer latching efficiency of more than 99 % the stretch parameter would have to be increased from 14 to about 24 if we wanted to maintain diagnostic latching throughout the trigger window. This could be an acceptable solution since the natural width of the signals is much wider than that.
- If we don't care about the later part of the window (as TKR told me they don't) we could shift the "shape" parameter from 11 to its maximum value of 15 and only increase the stretch from 14 to 20 for 99 % latching efficiency.

Conclusions and Summary

- We may have to take special runs with non-standard settings for window width, stretch, and shape, if we have applications that rely on the TKR diagnostic data (e.g. for efficiency measurements)
- Any application that uses the TKR diagnostic data has to be very careful about the interpretation of the results since the latching of the data is not done in a trivial, straightforward way.
- As a reminder, the calorimeter is not affected by any of this. All CAL diagnostic data can be latched properly.